Systematics of *Tephrosia* Pers. (Fabaceae: Millettiae) in Queensland: 1. A summary of the classification of the genus, with the recognition of two new species allied to *T. varians* (F.M.Bailey) C.T.White

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Summary

Pedley, L. (2014). Systematics of *Tephrosia* Pers. (Fabaceae: Millettiae) in Queensland: 1. A summary of the classification of the genus, with the recognition of two new species allied to *T. varians* (F.M.Bailey) C.T.White. ***Austrobaileya* 9(2): 229–243**. The classification and nomenclature of *Tephrosia* is reviewed and the names *Brissonia* Desv., *Tephrosia* section *Brissonia* DC. and *Tephrosia* section *Recueria* Benth. are lectotypified. An account of the species group surrounding *T. varians* is provided with description of the new species *T. delicatula* Pedley and *T. turpinii* Pedley.

Key Words: Leguminosae, Fabaceae, *Brissonia*, *Tephrosia*, *Tephrosia* section *Brissonia*, *Tephrosia* section *Recueria*, *Tephrosia delicatula*, *Tephrosia turpinii*, *Tephrosia varians*, Australia flora, Queensland flora, taxonomy, new species, identification key, distribution maps

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Introduction

Tephrosia Pers. is a 'taxonomically difficult' genus of an estimated 300 – 400 species (Lewis *et al.* 2005) distributed mainly in the tropics and subtropics of both the Old and New World. This figure could well be an underestimate; however, as studies of the genus in eastern Australia suggest that there are up to three times as many undescribed species as there are already described ones. This is the first of a series of papers that review the systematics of the genus over the eastern part of its range in Australia.

Classification & Nomenclature

Wood (1949) gave a clear account of the convoluted nomenclatural history of *Tephrosia*. In brief, the name is conserved with the previously published *Erebinthus* Mitch. (1769), *Needhamia* Scop. (1777) and *Reineria* Moench (1802) as *nomina rejecienda*. *Cracca* L. (1753) is also the same as *Tephrosia* but the name has been rejected in favour of *Cracca* Benth. (1853). This in turn, is also conserved but is now considered a synonym of *Coursetia* DC. (for example, by Estrada & Martinez 2003). Though *Tephrosia* was conserved at the International Botanical Congress of 1905 (*fide* Wood *op. cit.*), adherents of the 'American Code' continued to recognise *Cracca* L. until the 1930s. Conservation merely endorsed the decision of Candolle (1826) to adopt the name because Linnaeus applied the name *Cracca* in *Flora Zeylandica* (1747) differently from his use of it in *Species Plantarum* (1753). However, Weatherby (1935) opined that "neither *Tephrosia* nor *Cracca* L. ought ever to have been proposed". Today conservation of *Tephrosia* would certainly be accepted but probably not that of *Cracca* Benth.

Persoon (1807) accepted 39 species (two described for the first time) in *Tephrosia* but did not subdivide the genus in any way. Candolle (1826) had little doubt that the genus would have to be divided into several genera, but that in the state of knowledge at the time he believed it more prudent to erect simple sections[1]. Candolle (1825) had recognised

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1 'J'ai peu doute qu'il devra un jour être divisé en plusieurs genres; mais dans l'état actuel des connaissances, j'ai cru plus prudent d'en former de simple sections'.

74 species (18 of them with some doubt) distributed among four sections, namely: *Brissonia* DC., *Craccoïdes* DC., *Reineria* Moench and *Mundulea* DC. The type of the genus, *T. purpurea* (L.) Pers. (see Jarvis 2007), was referred by Candolle to section *Reineria*, which therefore becomes section *Tephrosia.*

Brissonia was published by Necker in *Elementa Botanica* (1790) as a "*species naturalis*". These were given unitary designations which resemble generic names, but are not to be treated as such. Necker's publication is listed in Appendix IV of the ICBN among *Opera unitqua appressa* and the name *Brissonia* is therefore not validly published. It was later validated as a generic name by Desvaux (1814). Though his name is illegitimate as he cited two generic names as synonyms, it does not prevent its use as a sectional name. Candolle used *Brissonia* as a sectional name, attributing it to Necker, but did not include in it any of the species of *Brissonia* Desv. He treated these among the 'Species non satis notae'. The sectional name *Brissonia* must therefore be attributed to him alone, not to (Desv.) DC. Lectotypification of the names *Brissonia* Desv. and *Tephrosia* section *Brissonia* DC. is essential if classifications of the genus after Candolle are discussed. Three of the species of sect. *Craccoïdes* are now referred to *Coursetia* DC., and the other to *Lotus* L. (*fide* Ottley 1944: 101).

Brissonia Desv., *J. Bot. (Desvaux)* 3: 78 (1814). **Lectotype** (chosen here): *Tephrosia coronillifolia* Desv., *loc. cit.*.

Tephrosia section *Brissonia* DC., *Prodr.* 2: 249 (1825). **Lectotype** (chosen here): *Tephrosia virginiana* (L.) Pers.

Meyer (1836) made a significant, perhaps undervalued, contribution to the classification of the genus. He described *Apodynomene* E.Mey., differing from *Tephrosia* in having ovate stipules similar to its spathaceous caducous bracts, and transverse seeds. In it he recognised two sections: *Epibrissonia* E.Mey. (three species) with barbate styles and *Epireineria* E.Mey. (one species) with glabrous styles. Harvey (1862) reduced the genus to sectional rank under *Tephrosia.*

Bentham (1859) placed South American species in two sections: *Brissonia* (three species) and *Recueria* sect. nov. (four species). They differed mainly in attributes of pods and calyces. Candolle (1825) had previously put two species of section *Recueria* in section *Reineria* (= section *Tephrosia*), and to endorse such placement section *Recueria* is lectotypified here.

Tephrosia section *Recueria* Benth., *Fl. Bras. (Martius)* 15(1): 47 (1859). **Lectotype** (chosen here): *Tephrosia leptostachya* DC.

T. leptostachya is sometimes considered to be conspecific with *T. purpurea*, the type of *Tephrosia*.

Later Bentham (1863) considered the genus as a whole. Since his classification greatly influenced subsequent workers, it deserves detailed examination. Probably following the principles set out by him and Hooker for the publication of *Genera Plantarum* (see Stevens 1996) he adopted a wide circumscription of the genus as he did for other large legume genera such as *Desmodium* Desv. and *Rhynchosia* Lour. He reviewed the classification, adding generic synonyms, and recognised three sections: (i) *Brissonia*, (ii) *Tephrosia* (as *Reineria*) and (iii) *Requienia* (described by Candolle as a distinct genus). He did not mention either section *Recueria* or section *Craccoïdes* and excluded section *Mundulea*, which he had raised, rather perfunctorily, possibly acting on a suggestion of Candolle (1826), to generic rank (Bentham 1852). The genera *Apodynomene*, *Macronyx* Dalziel and *Pogonostigma* Boiss. were discussed briefly but included in section *Tephrosia*, though he noted the first of these might be recognised as a subsection. As part of a large regional work, Bentham (1864) described 24 species all except one as new. The other, *T. purpurea*, was accepted with the addition of five varieties all confined to Australia. He referred all species "with the exception perhaps of *T. flammea* and *T. crocea* to section *Reineria*, with terminal or leaf-opposed racemes or axillary clustered pedicels, and to the large

subsection with subulate or small stipules, except *T. venulosa* [sic, perhaps a *lapsus calami* for *T. reticulata* Benth.] in which they are broad and striate but not so much so as in the S. African Apodynomenes".

J.G. Baker (1878) treated *Brissonia* as a subgenus, with *T. candida* DC. as sole species, as well as subgenus *Macronyx* (Dalziel) Baker (one species) and subgenus *Reineria* (DC.) Baker. In his diagnosis of section *Brissonia* Candolle (1825) had "Stylus lateriter barbatus" but referred *T. candida* to section *Mundulea* though noting in the description of the section that it was exceptional in having "stylus ... barbatus". He (Candolle 1826) discussed its position in the genus, although it is difficult to understand on what grounds his decision was made. Bentham had included *Macronyx* in section *Reineria*. E.G. Baker (1926) divided the genus into three: (i) *Eutephrosia* [= section *Tephrosia*], which included section *Brissonia* and section *Reineria*, (ii) *Pogonostigma* Boiss. (included by Bentham in section *Reinera*), and (iii) *Requienia*. The latter two contained two and one species respectively. The remaining 142 species were distributed among 42 series, none formally named.

Since Bentham and the Bakers many of the critical studies of the genus have been concentrated at herb. Kew with emphasis on the flora of the former British colonies in eastern and southern Africa. Notable exceptions are Domin (1926), Forbes (1948) and Wood (1949). Domin's contribution to the taxonomy of the Australian species is significant, though not a monograph as it was termed by Wood (1949). He recognised 22 species, one (*T. baueri* Benth.) included by Bentham under *T. purpurea*, two previously described by him (Domin 1912) and nine described as new, one of them (*T. affinis*) with an illegitimate name. He did not list 15 of the 23 species accepted by Bentham (1864). Forbes revised South African species of the genus. She described 67 species, more than a third of them for the first time, distributed among four unnamed sections. These sections seem aids to identification rather than groupings of taxonomically related species; for example, in its protologue *T. inandensis* H.M.L.Forbes was compared with *T. grandiflora*, which was placed in a different section. Wood (1949) published a comprehensive account of the "barbistyled" species of *Tephrosia* in north America. He noted that in his studies that the New World species fell "into two rather natural groups: those with glabrous styles and those with bearded or barbate styles".

In preliminary studies for the *Flora of Tropical East Africa*, Gillett (1958) also recognised that the genus included some species with glabrous styles and others with styles with indumentum of some sort ("barbistyled"). This is more or less in accord with distinctions between Candolle's sections *Reineria* and *Brissonia*. He also pointed out that *T. aurantiaca* Harms and a few allied species constituted a distinct group which might be considered outside the glabri-/barbistlyed division of the genus. The basis for this suggestion was *inter alia* the reticulation of the tertiary veins of the leaflets of the species. Wood (1949) had already emphasised the significance of both the indumentum of the style and the tertiary venation of the leaflets.

Brummitt (1980) took up Gillett's and presumably Wood's work and formally recognised *Tephrosia* subgenus *Barbistyla*, without referring either to section or subgenus *Brissonia*. He did not pursue Gillett's notes on *T. aurantiaca*, failing to mention the detailed discussion of the occurrence of pubescent styles among African species (Gillett 1959). Instead he concluded that "it seems best to refer the entire *T. aurantiaca* group, including *T. hockingii* subsp. *hirsutostyla* (Dewit) Gillett to the typical subgenus" and seems to have considered the venation of leaflets of little significance. He discussed the status of satellite genera, three of which had been described after the Bakers' treatments. Of these he maintained *Requienia* and *Ptycolobium* Harms as distinct but believed that *Caulocarpus* E.G.Baker and *Linophyllum* Hutch. were not different from *Tephrosia*. Bosman & de Haas (1983) rejected Brummitt's subgenera on the grounds of a lack of correlation between penicillate stigmas and indumentum of styles, and "furthermore it appeared to be impossible

to correlate the pubescence of the style with any other character, except that that the barbistyled species have larger flowers ...". Of the 20 species treated by them only the four introduced species are barbistyled. They foreshadowed the treatment of Geesink (1984) who admitted to only a limited knowledge of *Tephrosia*. He recognised all four genera discussed by Brummitt. Schrire (1987) supported Brummitt's division of the genus and added significantly to definitions of the subgenera. Brummitt (2007) presented a key to 70 species; species 1–30 were referred to subgenus *Tephrosia*, species 32–70 to subgenus *Barbistyla*. The affinities of species 31, *T. miranda* Brummitt (known from only two specimens), were considered obscure. It has unusual pods but he suggested it might be related to *T. zoutpansbergensis* Bremek. and *T. villosa* (L.) Pers. despite its pubescent style. Both Brummitt (2007) and Schrire (1987) placed *T. candida* in *T.* subgenus *Barbistlya*. Unless the subgenus is defined more narrowly to exclude *T. candida*, it should be referred to *T.* subgenus *Brissonia* (DC.) Baker.

The position of *Mundulea* (DC.) Benth. vis-à-vis *Tephrosia* and *Millettia* Wight & Arn. has been disputed. Geesink (1984) noted it to be scarcely distinct from *Millettia*. Schrire (1990) when discussing *Tephrosia pondoensis* (Codd) Schrire noted the differences between *Tephrosia* and *Mundulea*. He more or less dismissed the diagnostic value of attributes of leaf venation and dehiscence of pods, but stated that floral characters have proved more consistent in separating the two. Later some species of *Mundulea* were referred to the newly described *Pyranthus* Du Puy & Labat and *Sylvichadsia* Labat & Du Puy by Du Puy & Labat (1995) and Labat & Du Puy (1998) respectively. Both genera appear to be more closely related to another Madagascan genus *Chadsia* Bojer than to either *Tephrosia* or *Millettia*. Du Puy & Labat (2002) treated *Mundulea* as a distinct genus, but combined the key to its species with the key to those of *Tephrosia*; mainly because, contrary to the opinion of Schrire, attributes of their pods provided the most reliable differential characters and pods were often not available. Verdcourt (2007) iterated Bentham (1863) in noting that *Mundulea* "links *Tephrosia* with *Millettia*, but to combine it with either would lead to problems of definition. Certainly the three cannot be united, but *Mundulea* could perhaps be considered a subgenus of *Tephrosia*". I have examined only a few specimens of *M. sericea* (Willd.) A.Chev. the most widespread species of the genus; its calyx lobes are unlike those of any other species, African, Asian, north American or Australian I have seen but its general facies would place it in *Tephrosia*. Its dilated staminal filaments seem a minor attribute in distinguishing genera.

Differing opinions on the circumscription and status of *Tephrosia* subgenus *Barbistyla* seem to have inhibited the evaluation of characters other than stylar indumentum that might be significant for the classification of *Tephrosia* as a whole. Many workers have commented on the venation (or nervature) of the leaflets that they considered characteristic of the genus. For example, Forbes (1948): "There is one constant and conspicuous character by which the genus maybe readily recognised, the close distinct penninerved venation of the leaflets"; Bosman & de Haas (1983): "The intersecondary nerves are relatively numerous, parallel, rather straight (never S-shaped) and curved slightly upwards to the margin in which they usually end"; Geesink (1984): "the nerves are straight, forming a sharp angle (usually 10°–30°) with the midrib". Wood (1949: 210) and Gillett (1958) recognised minor variants of this pattern; Wood: "More or less parallel lateral veins are given off obliquely from the midrib of the leaflet in all species. The areoles formed by the veinlets between these veins are,... either elongate or isodiametric"; Gillett: "*T. aurantiaca* s. lat. is undoubtedly a very natural group, distinguished by ... rather large leaflets... with rather wide spaces between the chief lateral nerves and a very prominent network of venules connecting them". Rudd (1991), in a key to genera distinguished *Tephrosia* from *Mundulea* and *Millettia* by its "numerous straight, closely parallel lateral veins mostly extending to the margin".

Cowie (2004) drew attention to the differences and diversity of Australian species. In defining four groups of Australian species differing in their venation patterns, he upset established views. His first group, with *T. phaeosperma* F.Muell. ex Benth. as an example, corresponds to the accepted 'typical' pattern ; the second and third are difficult to place; the fourth is distinctive. It consists of "species with well spaced secondary veins curving or dichotomising before the margin, the intersecondary venation often closely reticulate, prominent or not". Bentham (1864) seems to have recognised this group indirectly where, in his key to species, the first five have "veins anastomosing or reticulate within the margin". It possibly requires the recognition of a genus distinct from *Tephrosia* and studies of Queensland species have strengthened my opinion that this is warranted.

Since *Tephrosia reticulata* Benth. and related species in the Northern Territory require further study, which I cannot undertake, I have retained the three reticulately veined species treated below in *Tephrosia*. In the protologue of *T. oxalidea* R.Butcher & P.J.H.Hurter, Butcher & Hurter (2012) provided detailed description of the venation of a reticulately veined species. Their somewhat diagrammatic illustrations of leaflets of *T. coriacea* Benth. (Fig. 1A) and *T. rosea* F.Muell. ex Benth. (Fig. 1D) contrast the reticulate venation of the former with the 'typical' venation of the latter.

In the relaxed atmosphere of the final session of the 16th Botanical Congress in St Louis in 1999, I suggested to some friends from herb. Kew that about 12 Australian species from northern Australia characterised by leaves with reticulate veins might be segregated as a separate genus (quoted in Lewis *et al.* 2005).

Except for indumentum of the style, attributes of inflorescences and flowers have been used in only a rather indefinite way to delimit infrageneric taxa in *Tephrosia*. Limited study of living and herbarium specimens; however, suggests that *Apodynomene* might be recognised as a distinct genus. In practice it has been treated as a coherent group of species by a succession of authors. Forbes (1948) placed most of the species in her 'section 4', a notable exception being *T. inandensis* in 'section 3', though, in its protologue, she compared it with *T. grandiflora* (L'Her. ex Ait.) Pers. (section 4), a species that is naturalised in the West Indies. Wood (1949: 374) noted that it is easily recognised: "The large, promptly deciduous bracts and broad stipules were largely the basis of the segregate genus *Apodynomene* E.Mey., of which this is the type-species. Although stipules and bracts of this type characterize a group of South African species, the absence of secondary bracts is indeed anomalous, there seem to be no real reasons for separating this group as a distinct genus". He considered Harvey's (1862) treatment of the group as a section might prove to be a more reasonable disposition. It should be noted that Wood effectively selected *T. grandiflora* as generitype of *Apodynomene*. Schrire (1987) in his notes on *T.* subgenus *Barbistyla*, commented: "within the subgenus *Barbistyla*, inflorescence characters (bracts) and fruit characters (pod size and seed position) separate the *T. grandiflora* allies from those of *T. longipes* [the type of the name *T.* subg. *Barbistyla*]. Inflorescence specialisation has been particularly marked in the *T. grandiflora* alliance". He keyed 11 species of this alliance more or less together (species No. 11–21) though he did not use absence of secondary bracts as a key character.

It might be expected that molecular analysis could suggest a plausible scheme for generic and infrageneric classification of *Tephrosia* and its allies. LPWG (2013) gave a comprehensive account of the advances and deficiencies in the 'building a high-resolution molecular phylogeny of legumes'. For an antipodean taxonomist it was not at all encouraging. Among the desiderata was "we must prioritise species-level phylogenetic investigations of known non-phylogenetic genera". How is one to know whether *Tephrosia* is phylogenetic or not? In the phylogram of Kajita *et al.* (2001) *T. heckmanniana* Harms and *T. grandiflora* formed a clade sister to one consisting of *Mundulea sericea* and *Chadsia versicolor* Bojer. da Silva *et al.* (2012), in a

study concentrated on *Lonchocarpus* Bojer, confirmed the monophyly of *Tephrosia*, presumably using Candolle's (1825) or Bentham's (1863) classification. Seven species were used in the study (not all shown in the published phylogram), all with 'typical' venation. A detailed molecular analysis of the genus, including species with 'atypical' venation, and purportedly related genera is necessary.

I have no doubt that Candolle (1826) was correct in his assessment that one day *Tephrosia* will need to be divided into several genera, but also agree with Cowie (2004) that "there is a need for further investigation of generic limits and infrageneric subdivisions".

Materials and methods

The species treated here are characterised by the reticulate venation of their leaflets. They fall into the fourth group of species defined by Cowie (2004) though the secondary and tertiary veins of their leaflets are more prominent than those of the species described by him. Only one of them (*T. gyropoda* Cowie) occurs in Queensland, near the Northern Territory border, some 600 km west of the nearest collecting locality of any of the other three species covered here. To some extent it resembles *T. delicatula*, but differs in the often cuneate bases of its leaflets which are sparsely pubescent on both surfaces and, above all, by its arillate seeds.

In this and future papers in the series, only the primary bract (the one subtending a fascicle of flowers in inflorescences) is described. Secondary bracts occur at the base of each flower of fascicles of all species examined, though sometimes they are early deciduous. Inflorescences of the type found in *Apodynomene* seem not to occur.

In all descriptions some modifications of customary terms have been adopted. Describing the architecture of leaves I have followed the terminology of Butcher & Hurter (2012, see particularly their fig. 1) with the addition of the term 'leaf axis', which denotes the length of petiole + rachis. Length of the leaf axis in descriptions removes uncertainty as to whether or not 'leaf-length' includes the length of the terminal leaflet. It does not. The calyx is 5-lobed, the lobes usually unequal, the upper pair (vexillary) united to some extent, the lowermost (carinal) often longer than the others. In most Australian species the calyx is therefore distinctly bilabiate. I have considered the two vexillary lobes as one, divided to some degree. The rather indefinite terms 'notched', 'split' and 'divided' are used to note the type of division. I have introduced the term 'knob' to describe the protuberances that usually occur on the basal part of the staminal sheath and adjacent part of the basally free anther-filament. These are sometimes called calluses or callosities but I have restricted the term callus (*pl.* calli) to the thickening of the basal part of the standard. The calli and knobs probably determine the attitude of the flower at anthesis and have rôles in its pollination.

Taxonomy

Key to species allied to *Tephrosia varians* from eastern Queensland

1 Leaves with (9–)11–15 leaflets, each (12–)16–24 mm × 8–12(–14) mm, (1–)1.5–2.2 times longer than wide; pedicels 10–16 mm long; flowers 8–10 mm long, apricot-orange; keel petals glabrous . . . . . **T. delicatula**

1. Leaves with (3–)5–7(–9) leaflets, each 25–60 mm × 6–25 mm, 1.3–4(–7) times longer than wide; pedicels 3–15 mm long; flowers 8–20 mm long, orange or yellow; keel petals pubescent or glabrous (or a few hairs on lower margin) **2**

2 Flowers yellow, 8–11 mm long; keel petals with loosely appressed hairs on lower margins or in proximal or distal half of lamina; pedicels 3–6 mm long; pods 4–6 mm wide. . . . . **T. varians**

2. Flowers apricot or orange, 15–20 mm long; keel petals glabrous or with a few appressed hairs on lower margins; pedicels 5–15 mm long; pods 6–10 mm wide. . . . . **T. turpinii**

Tephrosia varians (F.M.Bailey) C.T.White, *Proc. Roy. Soc. Queensland* 53: 214 (1942); *Galactia varians* F.M.Bailey, *Bot. Bull. Dept. Agric. Queensland* 10: 22 (1895); *Queensl. Fl.* 2: 430, t. 14 (1900). **Type:** Queensland. Cook District: Coolgarra [17°34′S 145°12′E], April 1895, *M.Butler s.n.* (holo: BRI [AQ22860]).

Tephrosia lutea F.Muell., *Fragm.* 5: 9 (1865) *nom. invalidum* & 9: 64 (1875) *pro syn.*

Sprawling (sub)shrub to *c.* 40 cm tall: annual stems from perennial carrot-like taproot. Branchlets at base of plant terete often with scattered ± spreading hairs to 0.5 mm long, becoming fluted, glabrous in upper part; stipules linear to narrow-triangular, indurated, 3–6 mm long, 1–8 veins depending on width; young growth bronzed. Leaves with 5–7(–9) leaflets; axis 70–90(–140) mm long, petiole 3–7.5(–9) cm long, interjugal rachis 15–30(–38) mm long, ultrajugal rachis (5–)10–25(–28) mm long; leaflets somewhat discolorous, oblong, ovate, occasionally obovate, (25–)30–60(–70) mm long, 6–25(–40) mm, rarely more, wide, 1.3–4 times longer than wide, rounded, sometimes truncate or emarginate at tip, cordate or occasionally rounded at base, glabrous except rarely a few hairs on margins or along midrib beneath; petiolules glabrous or with a few hairs, 1–2 mm long. Inflorescence terminal or leaf-opposed, 30–50 cm or more long, sparsely flowered in distal half; fascicles of 2 or 3 flowers, usually with an additional bud; subtending bract, to 2 mm long deciduous when only about as long as developing fascicles; pedicels 3–6 mm long, glabrous or sparsely appressed pubescent. Flowers 8–11 mm long, yellow, occasionally with red suffusion at base of standard; calyx glabrous to moderately dense pubescent, hairs short, appressed; tube 2–2.5 mm long, upper lobe wide-triangular or rarely rounded, 0.8–1.5 mm long, notched 0.1–0.3 mm, lateral lobes triangular 1–2(–2.4) mm long, sometimes curved when long, lower usually longer than laterals 1–2.3(–3.2) mm long, sometimes acuminate. Corolla: standard concave, hemispherical or reniform, emarginate, 5–8 mm long, 7–12 mm wide, usually with small thick prominent calli, claw (1–)2–2.5 mm long; wing petals longer than keel, often markedly so, 5.5–8.5 mm long, (2.5–)3–5 mm wide, auriculate, claw 2.2–3(–3.5) mm long; keel 4–5(–6) mm long, 2–2.7(–3) mm wide, pubescent with loosely appressed hairs along lower margin or in proximal half, claw 2–2.5(–3) mm long. Staminal sheath glabrous, knobs absent or poorly developed, anthers 0.4–0.6(–0.8) mm long; ovary pubescent with usually sparse appressed hairs, style flat and glabrous, geniculate at tip (*secus* Lee 1948), stigmatic surface inside. Pods oblong, flat, straight or slightly decurved, 45–60 mm long, 4–6 mm wide; valves cartilaginous, glabrous or sparsely appressed pubescent, up to 10–12 seeds, *c.* 4 mm between their centres, spongy tissue between them. Seeds (few seen mature) spherical, olive-brown, 3.6–3.8 mm diam.; small rim aril. **Fig. 1**.

***Additional selected specimens* (all BRI):** Queensland. Cook District: Cairns, Dec 1941, *Blake 14508*; *c.* 5 km SSW of Beagle North Camp, *c.* 3.7 km SSW of Weipa, Dec 1981, *Clarkson 4177*; 2 km S of the Big Coleman River on the Coen to Musgrave Road, May 1987, *Clarkson 7118 & Simon*; 30 km N of Wenlock River crossing on Peninsula Development Road, Aug 1987, *Clarkson 7326*; 10 km S of Wenlock River on Peninsula Development Road, Apr 1990, *Clarkson 8503 & Neldner*; 7 miles [11 km] N of Moreton Telegraph Station, Jul 1968, *Gittins 1826*; Whitewater Station, near boundary of Undara NP, Dec 2004, *McDonald KRM3230*; Undara NP, E of Mount Surprise, Jan 2005, *McDonald KRM3314*; Undara NP, E of Barkers Knob, Dec 2005, *McDonald KRM4684*; junction of Herberton – Petford – Irvinebank Roads, Feb 2006, *McDonald KRM4485*; 17.2 km W of Irvinebank, Mar 2007, *McDonald KRM6176*; near Emu Creek Station, 4.1 km E of road bridge, Jan 2008, *McDonald KRM7118*; SE of Mareeba, Jan 1982, *Pedley 4828* (+K, MEL); *c.* 28 km SSE of Laura, Jun 2006, *Wannan 4684 & Ray*; E of Musgrave on road to Marina Plains Station, Mar 2007, *Wannan* 4684 & *Beasley*. North Kennedy District: *c.* 0.5 km E of Button Rock, Mount Zero

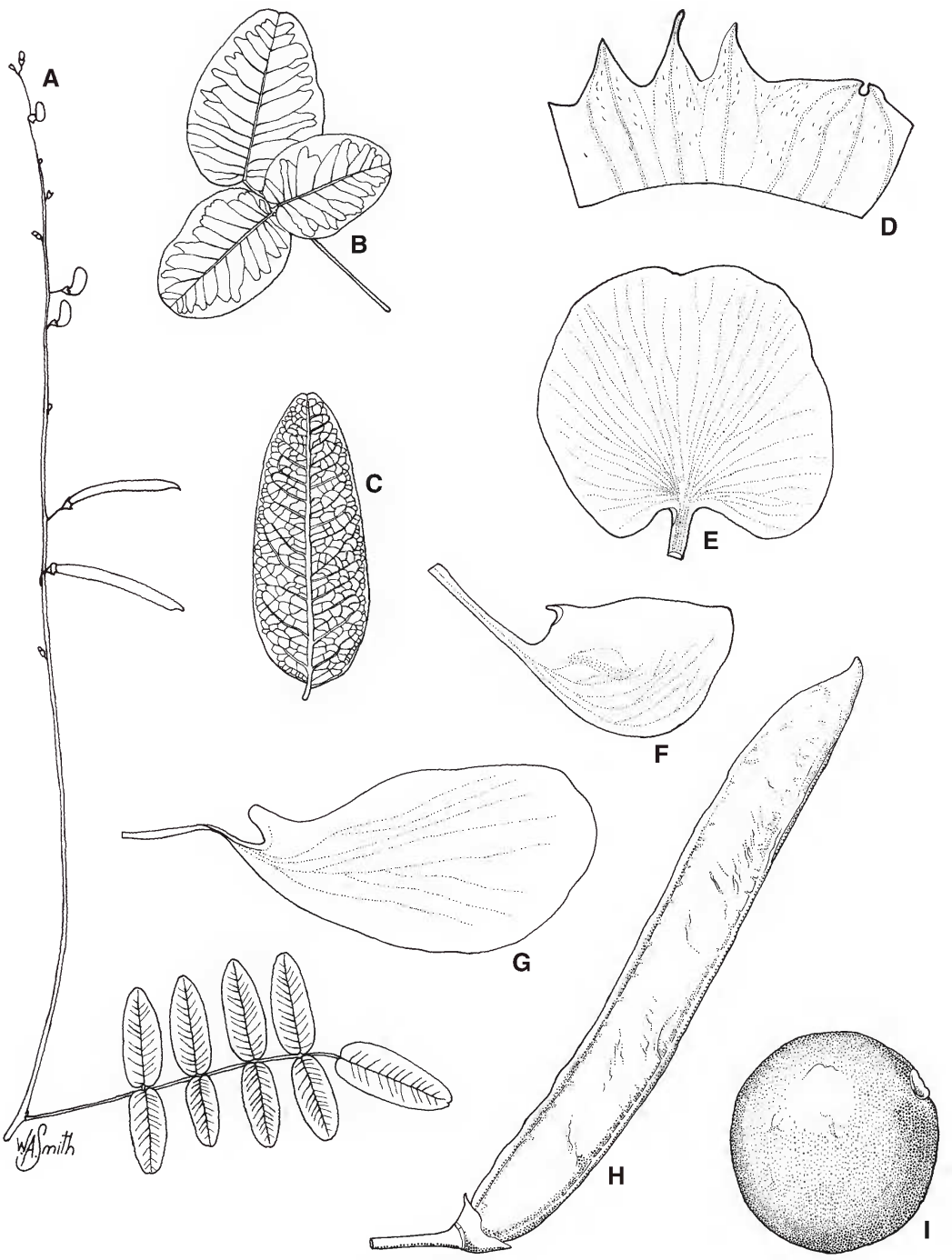

Fig. 1. ***Tephrosia varians***. A. twig with inflorescence ×0.4. B. trifoliolate leaf (leaflets unusually large) ×0.4. C. leaflet, showing venation ×1. D. calyx, outer surface ×6. E. standard ×4. F. keel petal ×6. G. wing petal ×6. H. pod (slightly immature) ×2. I. seed ×8. A from *McDonald KRM4685* (BRI); B from *McDonald KRM10308* (BRI); C–H from *McDonald KRM8682* (BRI); I from *Wannan 4449* (BRI). Del. W. Smith.

property, *c.* 80 km W of Townsville, Jan 2007, *Cumming 24593*; Stuarts River [near Townsville], in 1891, *Johnson s.n.* (+MEL 582909 & 582910); Herberton, Jan 1912, *Kenny s.n.* (AQ238666); Stuart, near Townsville, Nov 1940, *Watts s.n.* (AQ238661).

***Distribution and habitat*:** The species ranges from the northern part of Cape York Peninsula to about Townsville and inland to about Kidston (19°S, 144°E) (**Map 1**). It occurs in eucalypt woodland on well drained soils, mainly granitic sands in the south and red earths in the north.

***Notes*:** One specimen (*Clarkson 8503 & Neldner*) from south of the Wenlock River on the Peninsula Development Road and about 20 km from the collecting locality of *Gittins 1826* (cited above) is unusual. It is unifoliolate with longer petiolules and has shorter pods with more crowded seeds.

Mueller (1865) distinguished a species, evidently close to *Tephrosia reticulata* Benth, from the shores of Rockingham Bay. He stated that, if it differed, except for its 'perfect glabrosity' [my translation of the Latin], was to be called *T. lutea*. The name is not validly published as it is clearly a provisional one. Later (1875) he referred the species to *T. reticulata*.

Tephrosia turpinii Pedley, **sp. nov.** affinis *T. varianti* a qua floribus grandioribus aurantiis vel armeniacis non luteis petalis carinae plerumque glabris vel interdum pilis paucis secus marginem inferum praeditis et leguminibus latioribus paucioriseminalibus differt. **Typus:** Queensland. Cook District: near Emu Creek Station, 4.1 km by road E of Emu Creek bridge, 11 January 2008, *K.R. McDonald KRM7119 & A. Ford* (holo: BRI; iso: DNA).

Tephrosia sp. (Petford J.R. Clarkson 2774A); Holland & Pedley in Bostock & Holland (2010).

Similar in size and habit to *T. varians*. Young stems slightly angular becoming terete, indumentum of sparse appressed hairs 0.1–0.3 mm long, glabrescent; stipules linear to triangular, 3–6 mm long with up to 5 veins when wide. Leaves of (3–)5–7 leaflets, rarely extremely minutely stipellate; axis (5.5–)7–12.5(–14) cm long, petiole 3–7(–8) cm long, interjugal rachis 15–35(–45) mm long, ultrajugal rachis 4–20 mm long, rarely terminal leaflets digitate; leaflets slightly discolorous, oblong, elliptic or ovate, 25–55(–65) mm long, 8–22(–25) mm wide, (1.3–)2–3.5(–4) times longer than wide, rounded or somewhat truncate at tip, minutely mucronulate, rounded, often slightly emarginate or subcordate at base, glabrous above, glabrous or with extremely sparse short hairs beneath, petiolules 1–2 mm long. Inflorescence terminal or leaf opposed, 10–25(–35) cm long, open; fascicles of 2 or 3 flowers, subtending bract ovate, deciduous when *c.* 1 mm long, pedicel 5–15 mm long, sparse to dense appressed hairs. Flower 15–20 mm long, apricot or orange; calyx sparse to moderately dense appressed hairs; tube (2.2–)2.5 mm long, upper lobe wide triangular (1.5–)2–3 mm long, usually notched 0.3–0.7 mm, occasionally sinus between lobes wide, lateral lobes (1.5–)2–3 mm long, lower usually longer, (1.5–)2–4.5 mm long, all tending to be acuminate when long. Corolla: standard broadly transversely obovate or ± circular, (9–)11–16 mm long, (11–)12.5–16(–20) mm wide, thickened at base or with small thick calli, claw 2–3(–4) mm long; wing petals as long as or slightly longer than keel, (8–)12–15 mm long, 4.5–7.5 mm wide, not or only slightly auriculate, claw 2–3.5 mm wide; keel petals 8–12 mm long, 4–5(–6) mm wide, glabrous or occasionally sparse appressed hairs on lower margin; staminal sheath glabrous, knobs absent or poorly developed, anthers 0.8–1(–1.2) mm long. Ovary with dense appressed hairs; style glabrous, geniculate at tip, stigmatic surface inside angle occasionally with a few short hairs. Pods flat, straight, oblong, (40–)55–60 mm long, 6–10 mm wide, with up to 6 or 7 seeds, (4–)5.5–7 mm between their centres with spongy tissue between them; valves coriaceous, glabrous or with a few scattered short appressed hairs. Seeds flat, oblong in outline, 4.5–5 × 4–4.5 mm, small rim aril. **Fig. 2**.

***Additional selected specimens* (all BRI): Queensland.** Cook District: 16 km W of North Kennedy River on road from Fairview to Kimba Station, Dec 1981, *Clarkson 4205*; Burke Development Road, *c.* 11 km W of Petford, Feb 1981, *Clarkson 2774A*; Morgan's Folly,

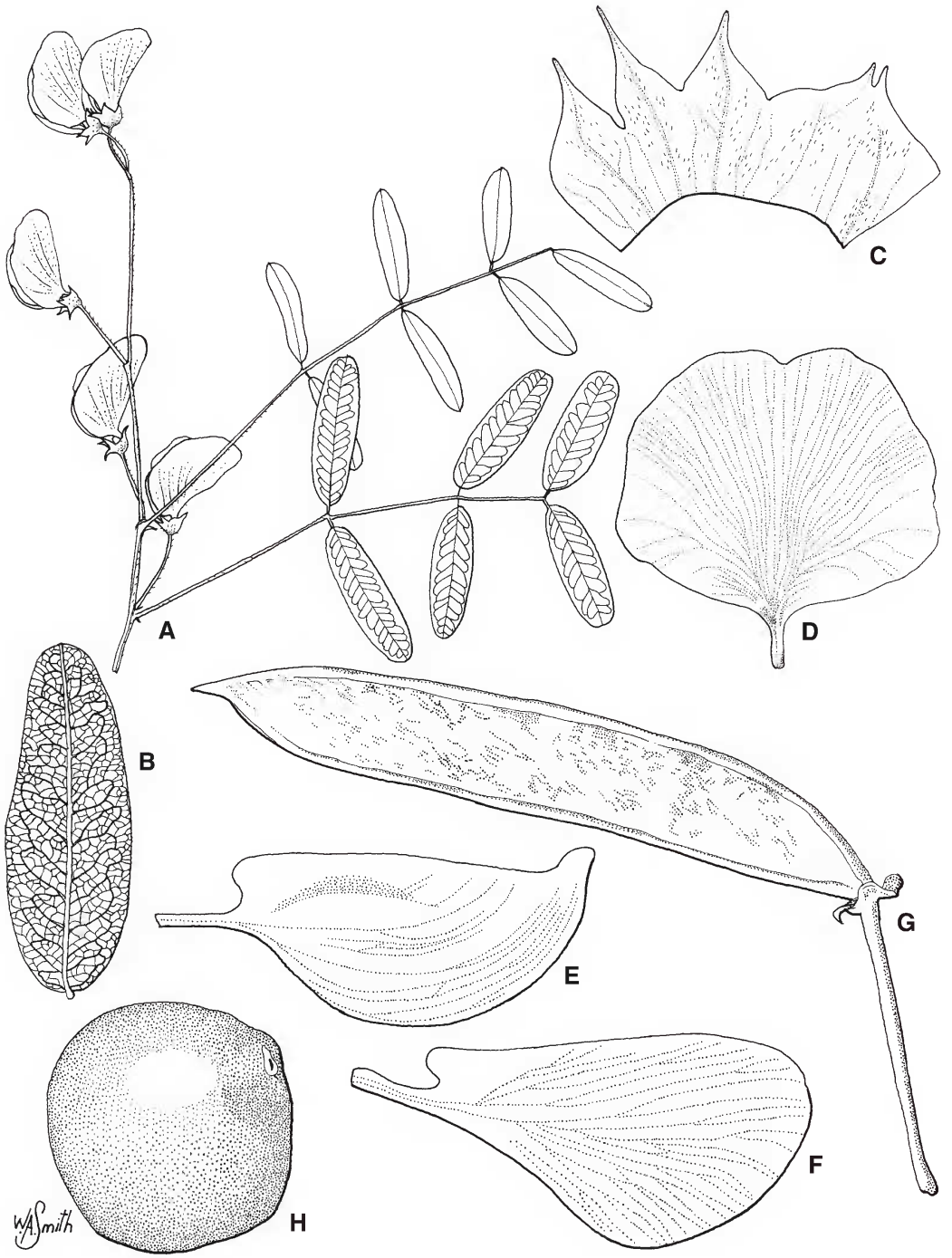

Fig. 2. ***Tephrosia turpinii***. A. twig with inflorescence ×0.8. B. leaflet, showing venation ×1. C. calyx, outer surface ×4. D. standard ×3. E. keel petal ×4. F. wing petal ×4. G. pod (slightly immature) ×2. H. seed ×8. A from *Wannan 1945* (BRI); B from *McDonald KRM7119* (BRI); C–F from *Ford AF2498* (BRI); G from *McDonald KRM3257* (BRI); H from *Wannan 5259* (BRI). Del. W. Smith.

38 km along road to Blackdown Station, off Chillagoe to Wrotham Park road, Feb 1994, *Forster PIF14754* (+DNA); Chillagoe, Jan 1931, *Hubbard & Winders 6759* (+K; cited by White (1942) as *T. varians*); Emu Creek Station between Emu Creek and Walsh River, Nov 2005, *McDonald KRM4614 et al.* (+DNA, NSW); 3.7 km by road W of Almaden, Dec 2005, *McDonald KRM4649* (+MEL); 64.4 km N of Laura near Weiss Creek, Nov 2010, *McDonald KRM10086* (+DNA, MEL); Lappa, Jan1982, *Pedley 4838A*; DPI experimental area, Kalinga Station, Jan 1976, *Staples IBS2241* (distributed as *T. varians*); Tate River, Feb 1938, *Straughan s.n.* [AQ238667]; cited by White (1942) as *T. varians*).

***Distribution and habitat*:** *Tephrosia turpinii* ranges from the northern part of Cape York Peninsula to 18°S latitude a little west of the Great Dividing Range (**Map 1**). Unlike *T. varians* it has not been collected in the Townsville area. It occurs in similar habitats to those of *T. varians*; that is: in eucalypt woodland on well drained soils mainly on granitic sands in the south and red earths in the north. The two species occasionally grow together.

***Etymology*:** The species is named for my friend and colleague Mr G.P. ('Gerry') Turpin, an elder of the Mbabarum people whose land includes that part of the distribution range where the species commonly occurs.

Tephrosia delicatula Pedley, **sp. nov.** affinis *T. varianti* a qua foliis foliolis pluribus minoribus petiolulis longioribus praeditis pedicellis longioribus floribus grandioribus aurantiacis non luteis carinae petalis ±glabris leguminibus longioribus angustoribusque differt. **Typus:** Queensland. Cook District: 6.8 km along Battle Camp Road from West McIvor Road junction, 8 January 2008, *K.R. McDonald KRM7106* (holo: BRI; iso: CNS, DNA, K, MEL *distribuendi*).

Twiggy multistemmed shrub to 50 cm tall, annual stems from perennial parsnip-like taproot; young stems reddish, terete, glabrous; young growth bronzed; stipules linear subulate to *c.* 6 mm long. Leaves with (9–)11–15 leaflets; axis 90–125 mm long, petiole 15–30(–35) mm long, interjugal rachis (8–)12–15(–18) mm long, ultrajugal rachis (2–)5–10 mm long; leaflets oblong elliptic or somewhat obovate, the terminal tending to be smaller than the laterals, (12–)16–24 mm long, 8–12(–14) mm wide, (1–)1.5–2.2(–2.4) times longer than wide, rounded, minutely mucronulate at tip, obtuse at base, slightly discolorous, glabrous or with a few scattered appressed hairs beneath, veins raised on both surfaces; secondary veins 8–15 on each side of midrib; petiolules 2–3 mm long. Inflorescence terminal, to *c.* 30 cm long, fascicles sparsely arranged in distal half, occasionally a fascicle in axil of subtending leaf; fascicle 3-flowered, subtending bract deciduous well before anthesis, 0.5–2 mm long, pedicel 10–16 mm long, glabrous or with scattered appressed hairs. Flowers 8–10 mm long, apricot-orange; calyx with sparse short appressed hairs, tube 2–2.5 mm long, upper lobe obtuse or occasionally acuminate, 1–1.6 mm long, notched for *c.* 0.2 mm, lateral lobes and lower lobe triangular, occasionally acuminate, laterals 1–1.6 mm long, lower 1.5–3 mm. Corolla: standard ± square, emarginate, 7–10 mm long, 10–11 mm wide, only thickened at base or calli well defined, claw wide, 1–1.3 mm long; wing petals longer and wider than keel, 7.5–9 mm long, 3.5–4.5 mm wide, shortly auriculate, claw 2–3 mm long; keel petals 5–6 mm long, 2.8–3.5 mm wide, glabrous, claw 2–3 mm long. Staminal sheath glabrous, knobs moderately developed, anthers 0.5–0.6 mm long. Ovary with dense appressed hairs; style flat and glabrous, geniculate at tip with stigmatic surface in angle. Pods (dehisced) straight, sparse appressed hairs, *c.* 50 mm long, 3–3.5 mm wide. Seeds spherical or almost so (only 3 seen mature), pale khaki in colour, 3.3–3.4 × 2.5–3.3 mm. **Fig. 3**.

***Additional specimens examined* (all BRI, duplicates to be distributed as indicated):** Queensland. Cook District: Battle Camp Road, Jan 2008, *McDonald KRM7112* (CANB, DNA, K, MEL, NSW), Apr 2008, *McDonald KRM7219 & Covacevich.*

***Distribution and habitat*:** *Tephrosia delicatula* is quite common in the vicinity of the type locality some 35 km NW of Cooktown (**Map 1**), where it is found in eucalypt woodland dominated by *Eucalyptus phoenicea* F.Muell.or *E. tetrodonta* F.Muell. and *Corymbia nesophila* (Blakely) K.D.Hill & L.A.S.Johnson on shallow soil on low sandstone hills.

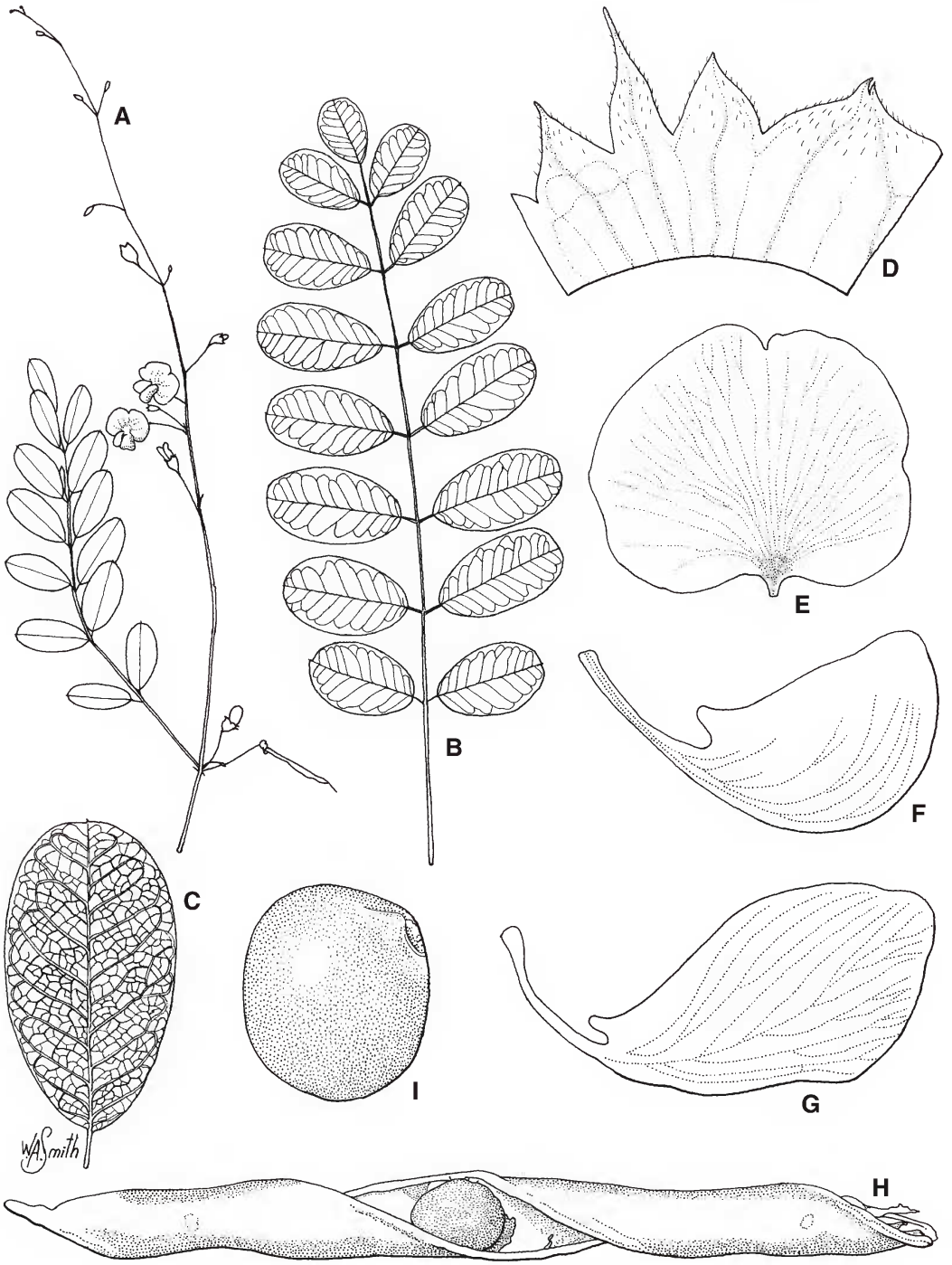

Fig. 3. ***Tephrosia delicatula***. A. twig with inflorescence ×0.5. B. leaf ×0.8. C. leaflet, showing venation ×2. D. calyx, outer surface ×6. E. standard ×4. F. keel petal ×6. G. wing petal ×6. H. pod ×2. I. seed ×8. A, D–G from *McDonald KRM7106* (BRI); B & C from *McDonald KRM7112* (BRI); H & I from *McDonald KRM7219* (BRI). Del. W. Smith.

***Notes*:** A specimen (*Bean 5564 & Forster* [BRI]) collected some 10 km west of the type locality and another (*S.L.Thompson ST13056* [BRI]), *c.* 240 km west of it, possibly represent hybrids with *Tephrosia varians* or *T. turpinii*. They have lanceolate leaflets longer than those of *T. delicatula* though their venation patterns are similar.

***Etymology*:** The specific epithet is from the Latin *delicata* and *-ula* and alludes to the smaller leaflets with finer venation when compared to those of both *T. varians* and *T. turpinii*.

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I wish to thank W. Smith for preparing the figures and map. Over a long period of time I've been able to access herbarium collections both in Australia and overseas, particularly at Kew; and I wish to thank the relevant staff for this.

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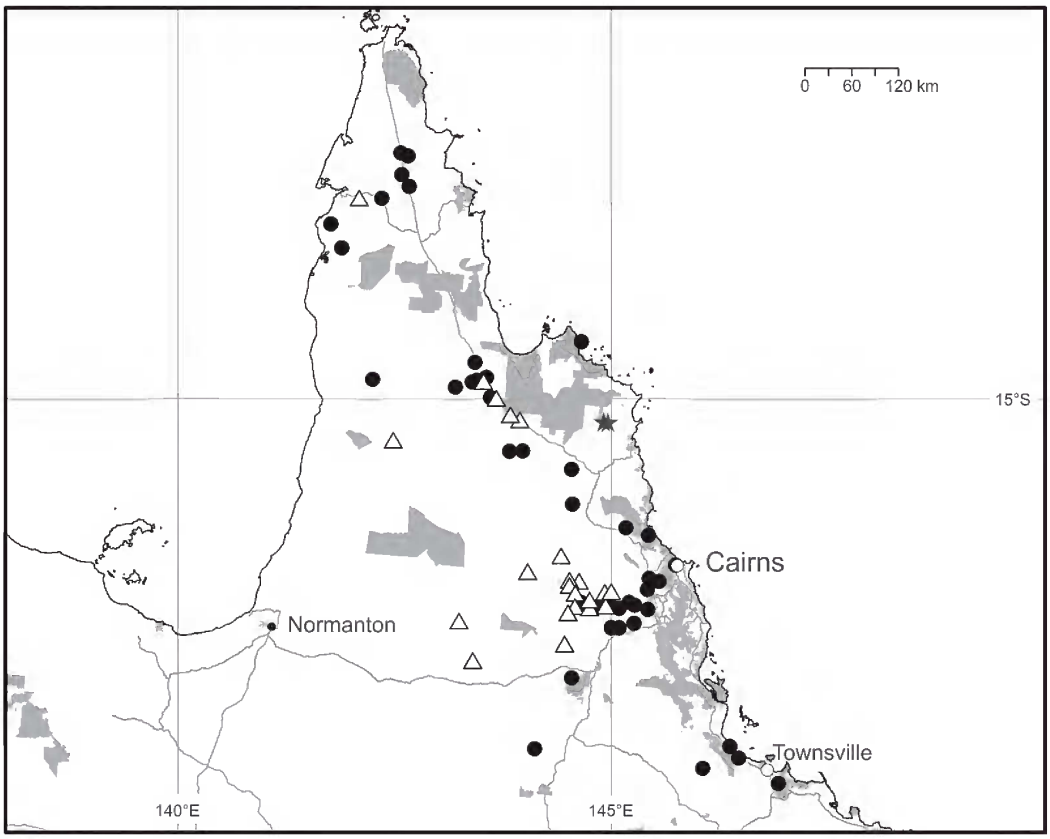

Map 1. Distribution of *Tephrosia delicatula* ★, *T. turpinii* △ and *T. varians* ●. N.B. specimens discussed under the Notes Section for *T. delicatula* are not mapped.